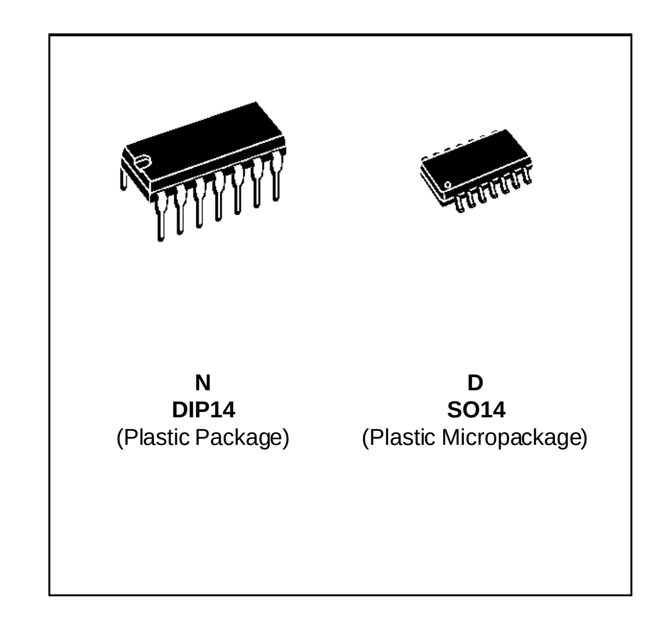


LM2902

LOW POWER QUAD OPERATIONAL AMPLIFIERS

- LARGE VOLTAGE GAIN : 100dB
- VERY LOW SUPPLY CURRENT/AMPLI : 375μA
- LOW INPUT BIAS CURRENT : 20nA
- LOW INPUT OFFSET CURRENT : 2nA
- WIDE POWER SUPPLY RANGE :
  SINGLE SUPPLY : +3V TO +30V
  DUAL SUPPLIES : ±1.5V TO ±15V



DESCRIPTION

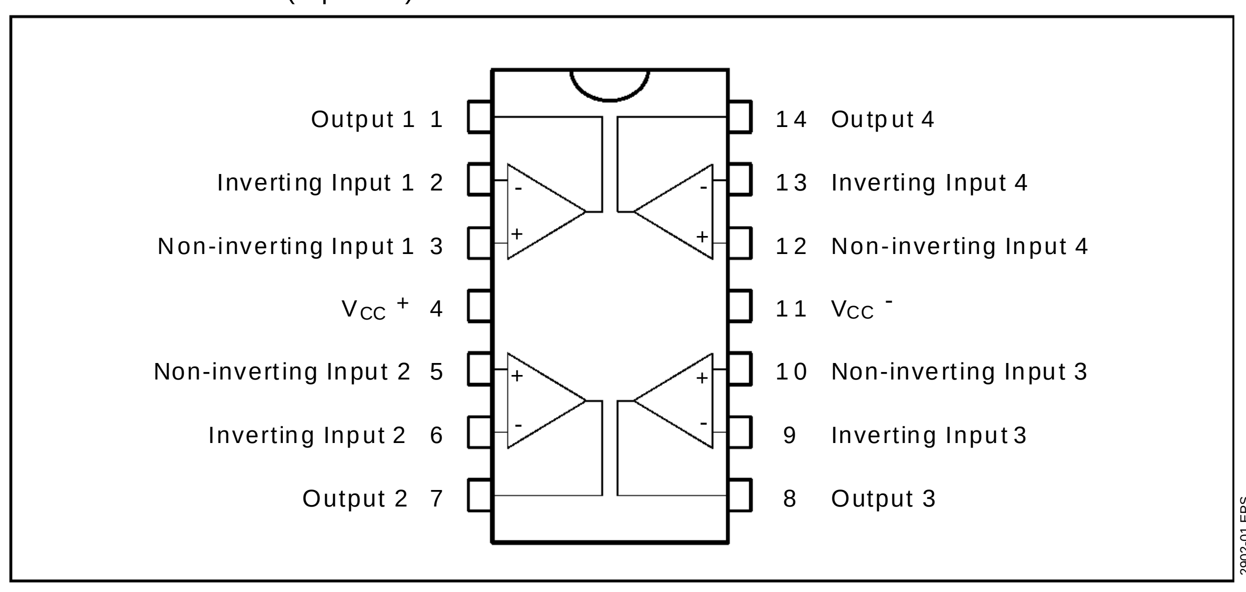
This circuit consists of four independent, high gain, internally frequency compensated operational amplifiers which were designed specifically for automotive and industrial control systems. It operates from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

ORDER CODES

Part Number	Temperature Range	Package	
		N	D
LM2902	-40°C, +125°C	•	•
Example : LM2902D			

2902-01.TBL

PIN CONNECTIONS (top view)



SCHEMATIC DIAGRAM (1/4 LM2902)

VCC
6µA
4µA
100µA
Q5
Q6
CC
Q2
Q3
Inverting input
Q1
Q4
Q7
R SC
Q11
Non-inverting input
Output
Q13
Q10
Q12
Q8
Q9
50µA
GND

2902-02.EPS

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{cc}	Supply Voltage	±16 or 32	V
V_i	Input Voltage	-0.3 to +32	V
V_{id}	Differential Input Voltage	+32	V
P_{tot}	Power Dissipation N Suffix D Suffix	500 400	mW mW
-	Output Short-circuit Duration - (note 1)	Infinite	
I_{in}	Input Current – (note 6)	50	mA
T_{oper}	Operating Free Air Temperature Range	-40 to +125	°C
T_{stg}	Storage Temperature Range	-65 to +150	°C

2902-02.TBL



ELECTRICAL CHARACTERISTICS

V_{CC}^+ = +5V, V_{CC}^- = Ground, V_O = 1.4V, T_{amb} = +25°C
(unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage (note 3) T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$		 2	 7 9	mV
I_{io}	Input Offset Current T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$		 2	 30 40	nA
I_{ib}	Input Bias Current (note 2) T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$		 20	 150 200	nA
A_{vd}	Large Signal Voltage Gain (V_{CC}^+ = +15V, R_L = 2kΩ, V_O = 1.4V to 11.4V) T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$	 50 25	 100		V/mV
SVR	Supply Voltage Rejection Ratio ($R_S \leq$ 10kΩ) (V_{CC}^+ = 5V to 30V) T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$	 65 65	 110		dB
I_{CC}	Supply Current, all Amp, no load T_{amb} = +25°C V_{CC} = +5V V_{CC} = +30V $T_{min.} \leq T_{amb} \leq T_{max.}$ V_{CC} = +5V V_{CC} = +30V		 0.7 1.5 0.8 1.5	 1.2 3 1.2 3	mA
V_{icm}	Input Common Mode Voltage Range (V_{CC} = +30V) - (note 4) T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$	 0 0		 V_{CC} -1.5 V_{CC} -2	V
CMR	Common-mode Rejection Ratio ($R_S \leq$ 10kΩ) T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max}$	 70 60	 80		dB
I_o	Output Short-circuit Current (V_{id} = +1V) V_{CC} = +15V, V_o = +2V	 20	 40	 60	mA
I_{sink}	Output Sink Current (V_{id} = -1V) V_{CC} = +15V, V_o = +2V V_{CC} = +15V, V_o = +0.2V	 10 12	 20 50		 mA µA

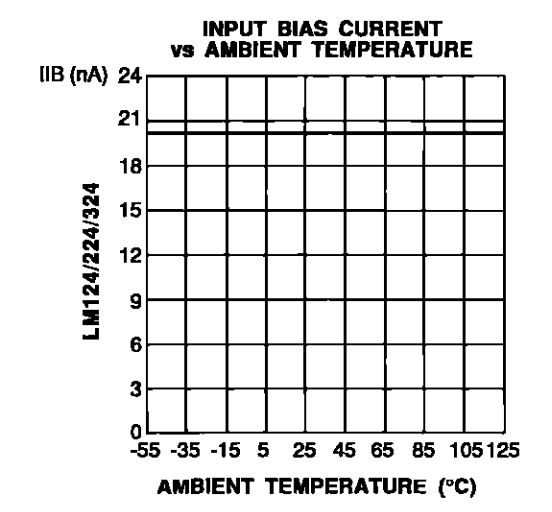
2902-03.TBL

ELECTRICAL CHARACTERISTICS (continued)

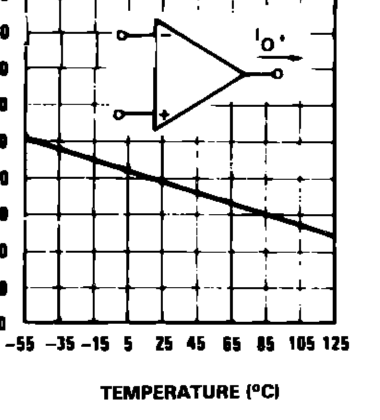
Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{OH}	High Level Output Voltage (V_{CC} = +30V) T_{amb} = +25°C R_L = 2kΩ $T_{min.} \leq T_{amb} \leq T_{max.}$ T_{amb} = +25°C R_L = 10kΩ $T_{min.} \leq T_{amb} \leq T_{max.}$ (V_{CC} = +5V, R_L = 2kΩ) T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$	 26 26 27 27 3.5 3	 27 28		V
V_{OL}	Low Level Output Voltage (R_L = 10kΩ) T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$		 5	 20 20	mV
SR	Slew Rate (V_{CC} = 15V, V_I = 0.5 to 3V, R_L = 2kΩ, C_L = 100pF, T_{amb} = +25°C, unity gain)		0.4		V/µs
GBP	Gain Bandwidth Product (V_{CC} = 30V f = 100kHz, T_{amb} = +25°C, V_{in} = 10mV R_L = 2kΩ, C_L = 100pF)		1.3		MHz
THD	Total Harmonic Distortion (f = 1kHz, A_V = 20dB, R_L = 2kΩ, V_O = 2V_{pp} C_L = 100pF, T_{amb} = +25°C, V_{CC} = 30V)		0.015		%
e_n	Equivalent Input Noise Voltage (f = 1kHz, R_s = 100Ω, V_{CC} = 30V)		40		$\frac{nV}{\sqrt{Hz}}$
DV_{io}	Input Offset Voltage Drift		7	30	µV/°C
DI_{IO}	Input Offset Current Drift		10	200	pA/°C
V_O1/V_O2	Channel Separation (note 5) 1kHz ≤ f ≤ 20kHz		120		dB

2902-04.TBL

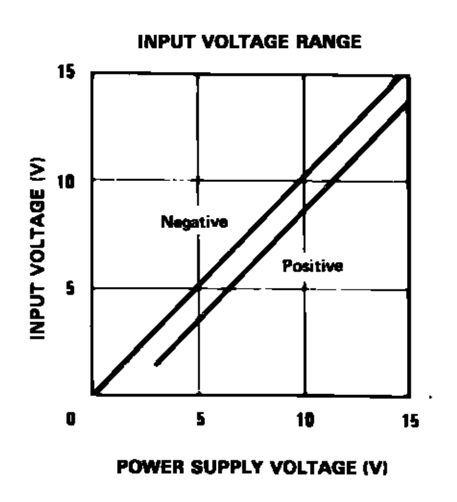
Notes :
1. Short-circuits from the output to V_{CC} can cause excessive heating if V_{CC} > 15V. The maximum output current is approximately 40mA independent of the magnitude of V_{CC}. Destructive dissipation can result from simultaneous short-circuit on all amplifiers.
2. The direction of the input current is out of the IC. This current is essentially constant, independent of the state of the output so no loading change exists on the input lines.
3. V_o = 1.4V, R_s = 0Ω, 5V < V_{CC}^+ < 30V, 0 < V_{ic} < V_{CC}^+ - 1.5V
4. The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is V_{CC}^+ - 1.5V, but either or both inputs can go to +32V without damage.
5. Due to the proximity of external components insure that coupling is not originating via stray capacitance between these external parts. This typically can be detected as this type of capacitance increases at higher frequences.
6. This input current only exists when the voltage at any of the input leads is driven negative. It is due to the collector-base junction of the input PNP transistor becoming forward biased and thereby acting as input diodes clamps. In addition to this diode action, there is also NPN parasitic action on the IC chip. this transistor action can cause the output voltages of the Op-amps to go to the V_{CC} voltage level (or to ground for a large overdrive) for the time duration than an input is driven negative.
   This is not destructive and normal output will set up again for input voltage higher than -0.3V.



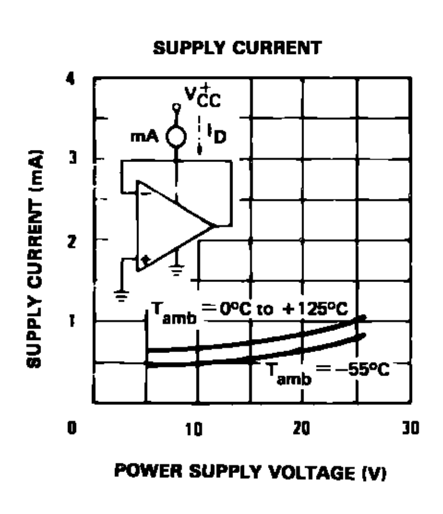
2902-03.EPS



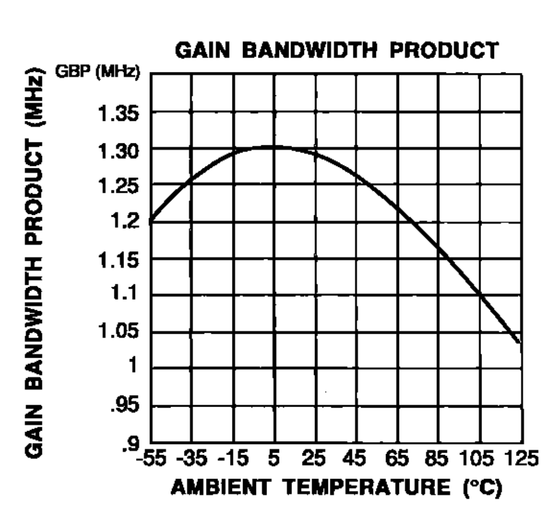
2902-04.EPS



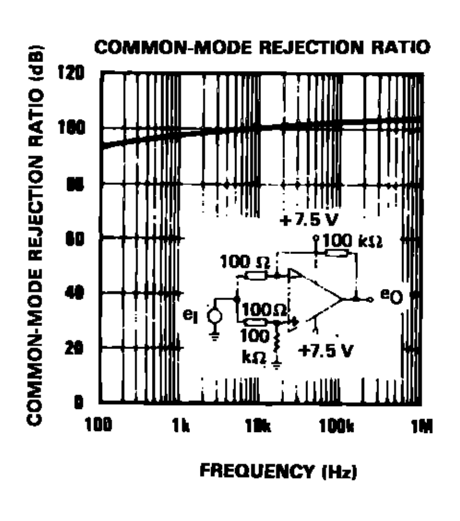
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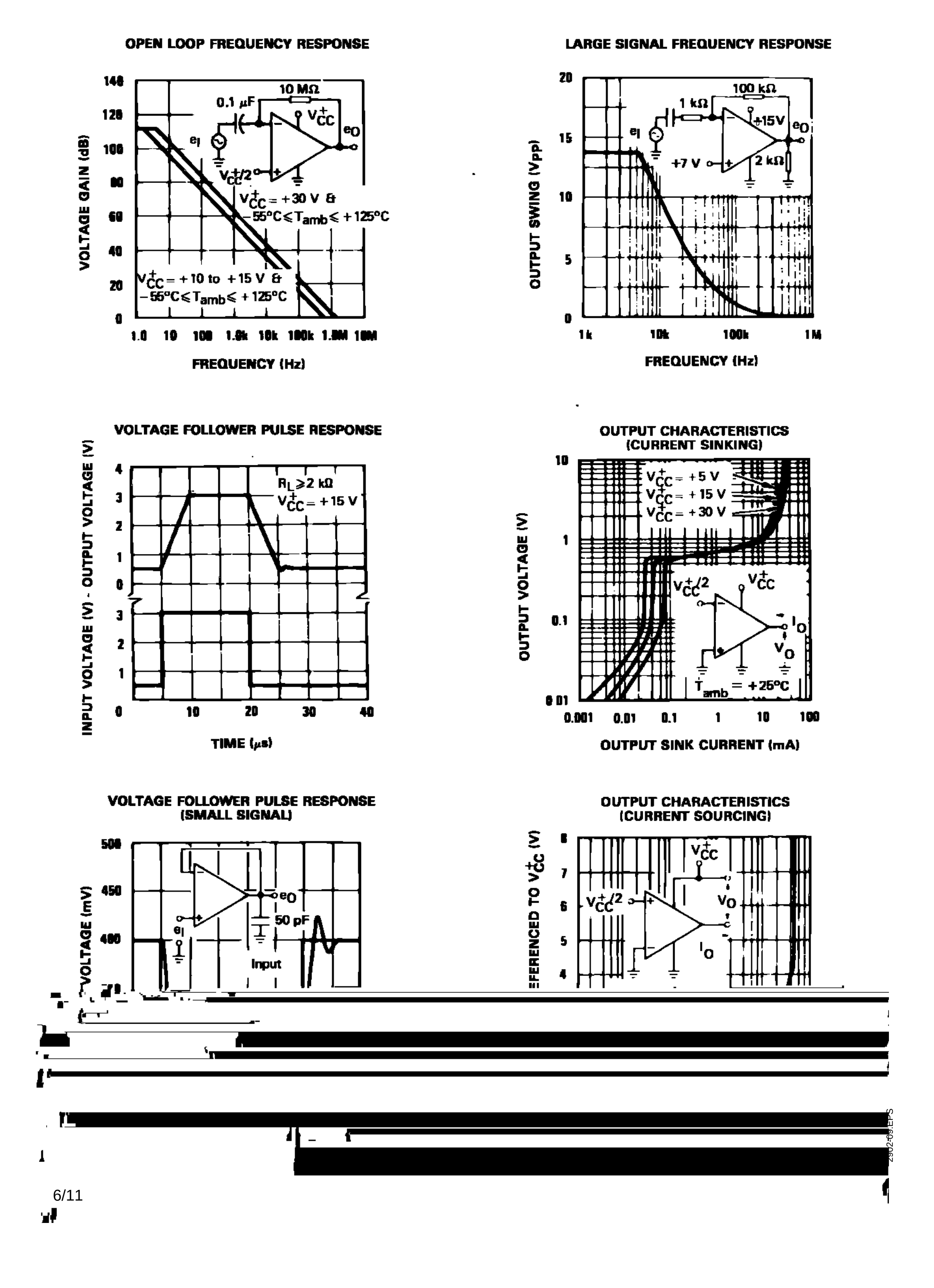
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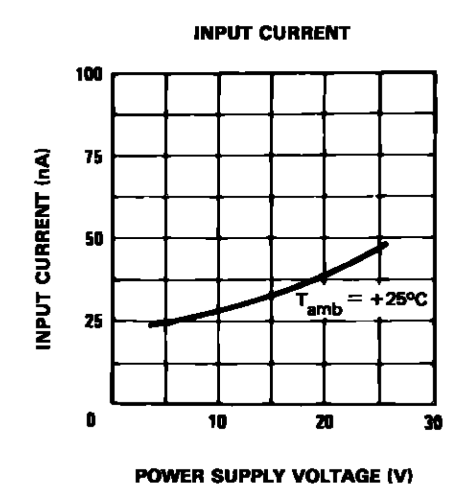
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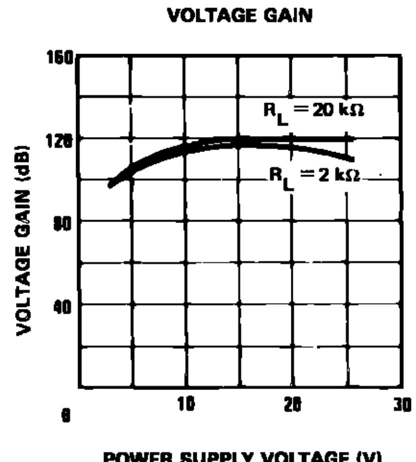
2902-08.EPS


OPEN LOOP FREQUENCY RESPONSE
VOLTAGE GAIN (dB)
FREQUENCY (Hz)
10 MΩ
0.1 μF
V_{CC}^{+} = +30 V & −55°C ≤ T_{amb} ≤ +125°C
V_{CC}^{+} = +10 to +15 V & −55°C ≤ T_{amb} ≤ +125°C
LARGE SIGNAL FREQUENCY RESPONSE
OUTPUT SWING (V_{pp})
FREQUENCY (Hz)
100 kΩ
1 kΩ
+15V
+7 V
2 kΩ
VOLTAGE FOLLOWER PULSE RESPONSE
INPUT VOLTAGE (V) - OUTPUT VOLTAGE (V)
TIME (μs)
R_L ≥ 2 kΩ
V_{CC}^{+} = +15 V
OUTPUT CHARACTERISTICS (CURRENT SINKING)
OUTPUT VOLTAGE (V)
OUTPUT SINK CURRENT (mA)
V_{CC}^{+} = +5 V
V_{CC}^{+} = +15 V
V_{CC}^{+} = +30 V
T_{amb} = +25°C
VOLTAGE FOLLOWER PULSE RESPONSE (SMALL SIGNAL)
VOLTAGE (mV)
50 pF
Input
OUTPUT CHARACTERISTICS (CURRENT SOURCING)

[redacted]

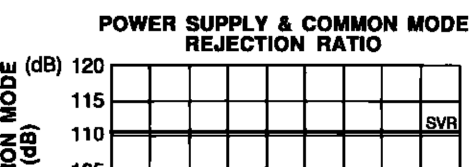


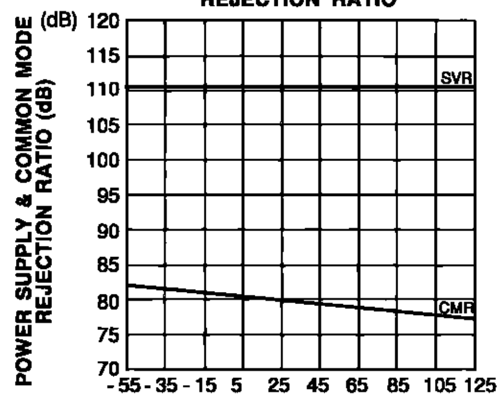
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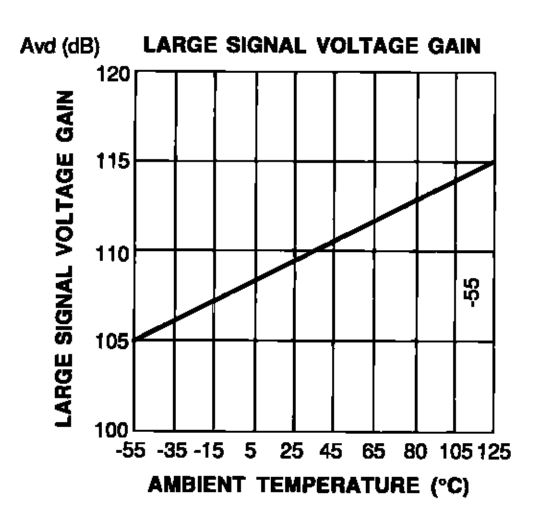


2902-11.EPS





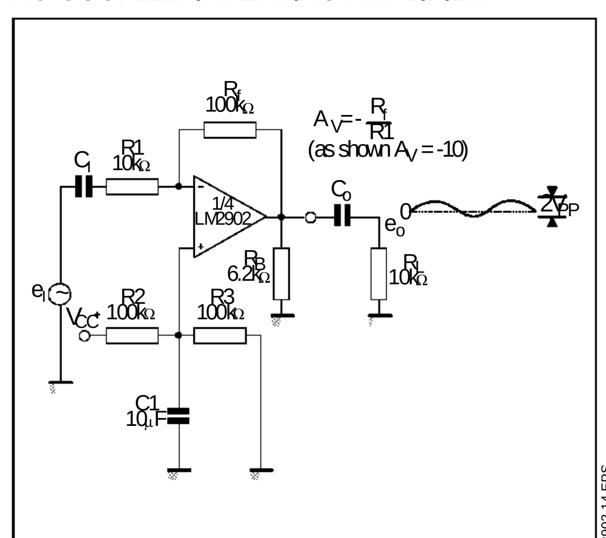
2902-12.EPS



2902-13.EPS

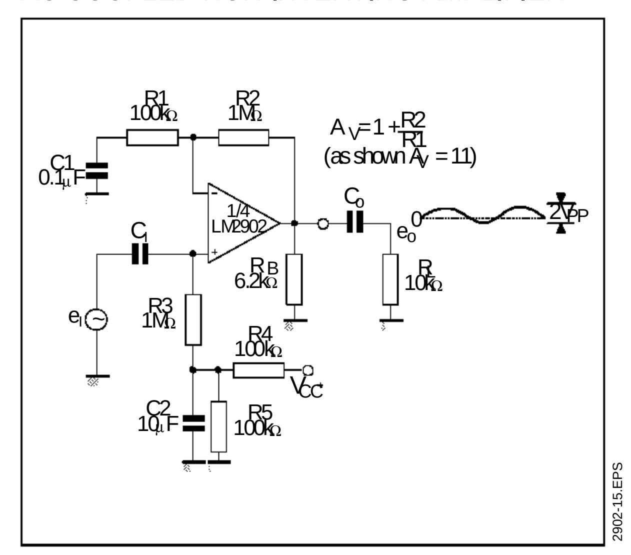
TYPICAL SINGLE - SUPPLY APPLICATIONS

AC COUPLED INVERTING AMPLIFIER



2902-14.EPS

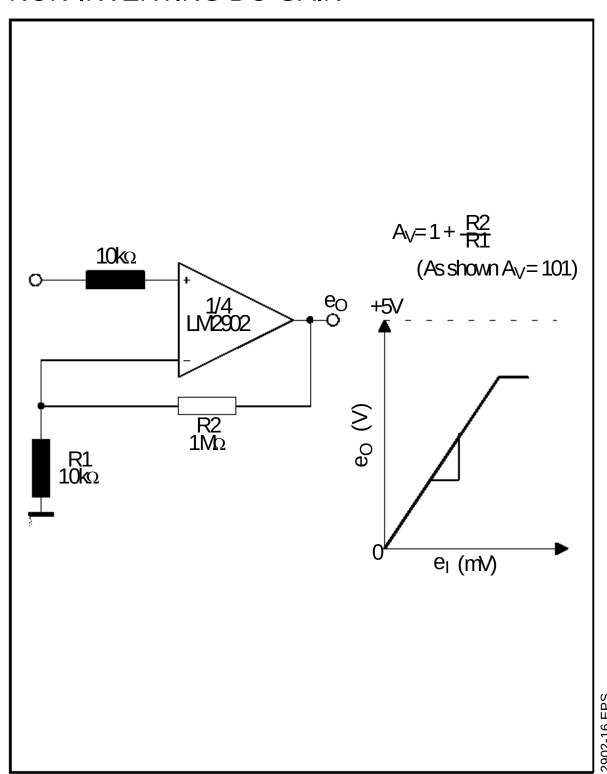
AC COUPLED NON-INVERTING AMPLIFIER



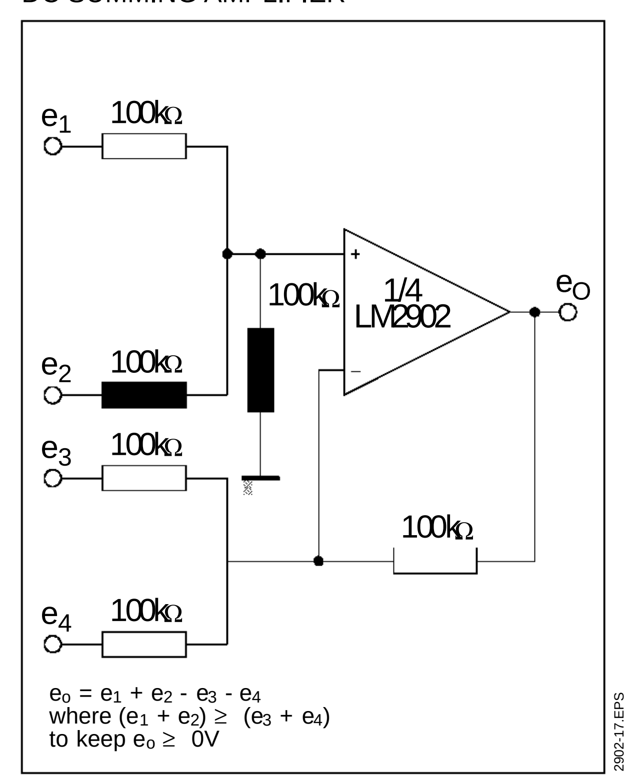
2902-15.EPS

TYPICAL SINGLE - SUPPLY APPLICATIONS

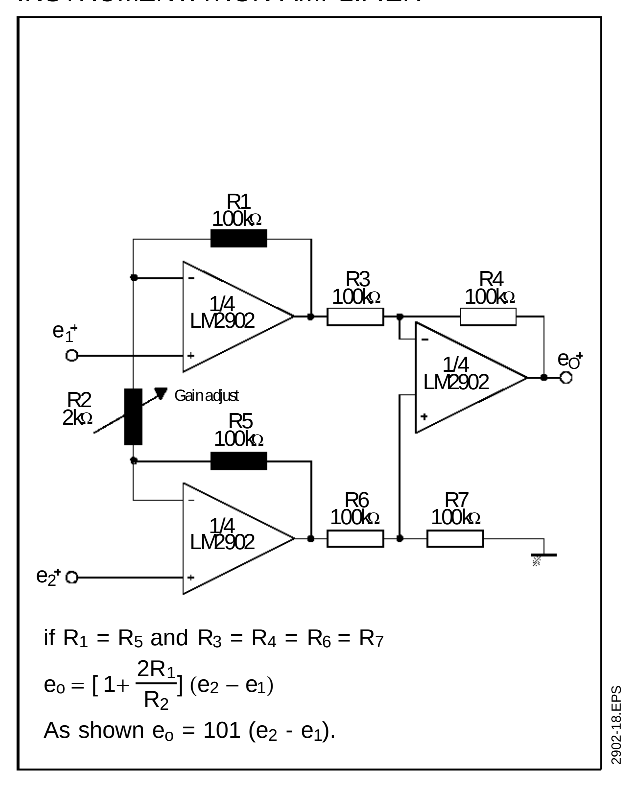
NON-INVERTING DC GAIN



DC SUMMING AMPLIFIER



HIGH INPUT Z ADJUSTABLE GAIN DC INSTRUMENTATION AMPLIFIER

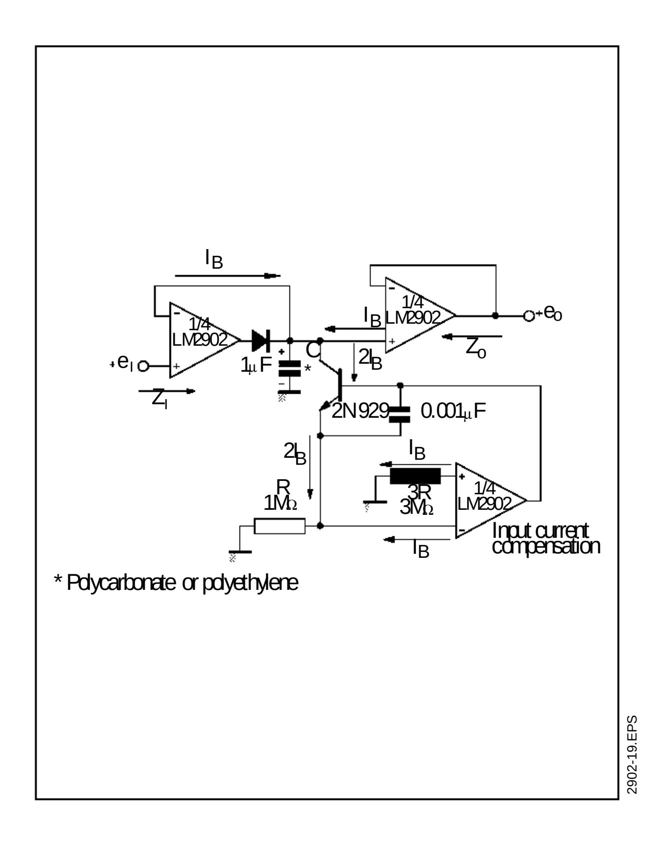


if $R_1 = R_5$ and $R_3 = R_4 = R_6 = R_7$

$$e_o = \left[1 + \frac{2R_1}{R_2}\right](e_2 - e_1)$$

As shown $e_o = 101\ (e_2 - e_1)$.

LOW DRIFT PEAK DETECTOR



TYPICAL SINGLE - SUPPLY APPLICATIONS

ACTIVER BANDPASS FILTER

R1 100kΩ
C1 330pF
R5 470kΩ
1/4 LM2902
e_1
R4 10MΩ
C2 330pF
R3 10kΩ
R6 470kΩ
e_O
R7 100kΩ
V_{CC}^+
R8 100kΩ
C3 10µF

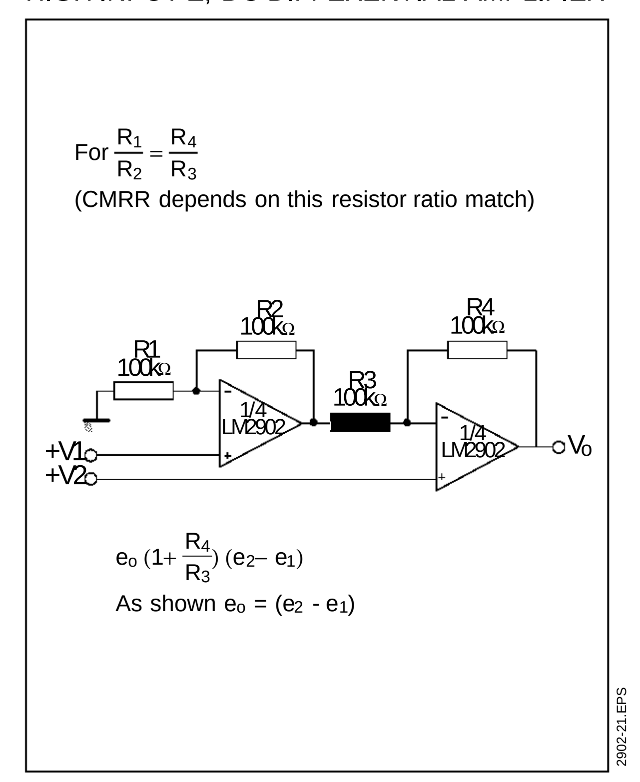
F_O = 1kHz

Q = 50

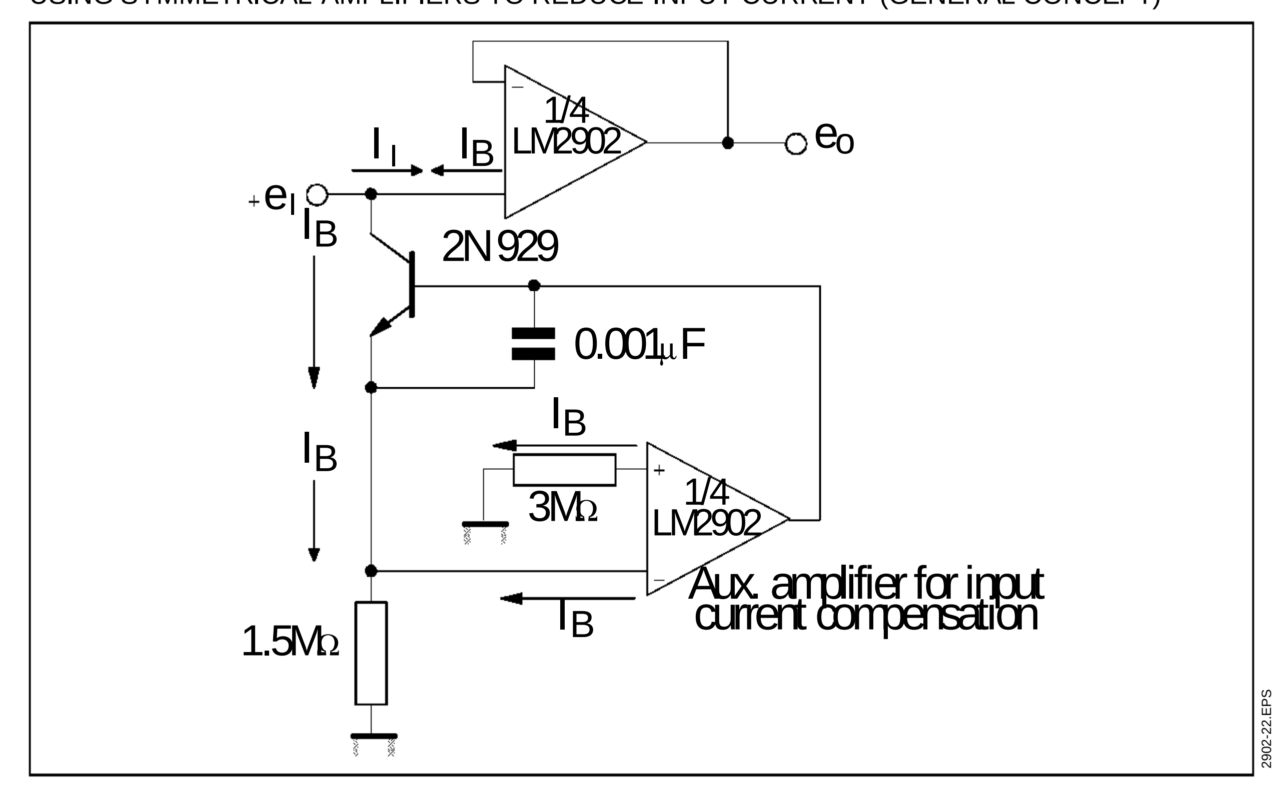
A_V = 100 (40dB)

2902-20.EPS

HIGH INPUT Z, DC DIFFERENTIAL AMPLIFIER

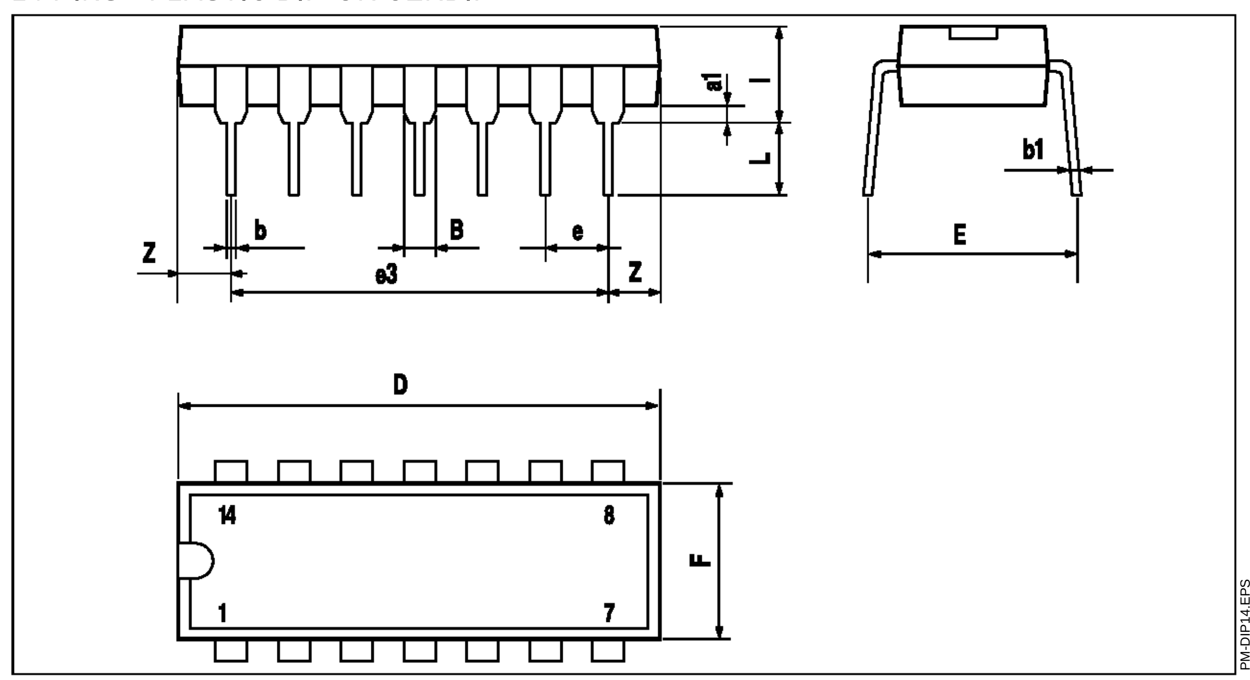


USING SYMMETRICAL AMPLIFIERS TO REDUCE INPUT CURRENT (GENERAL CONCEPT)



PACKAGE MECHANICAL DATA

14 PINS - PLASTIC DIP OR CERDIP

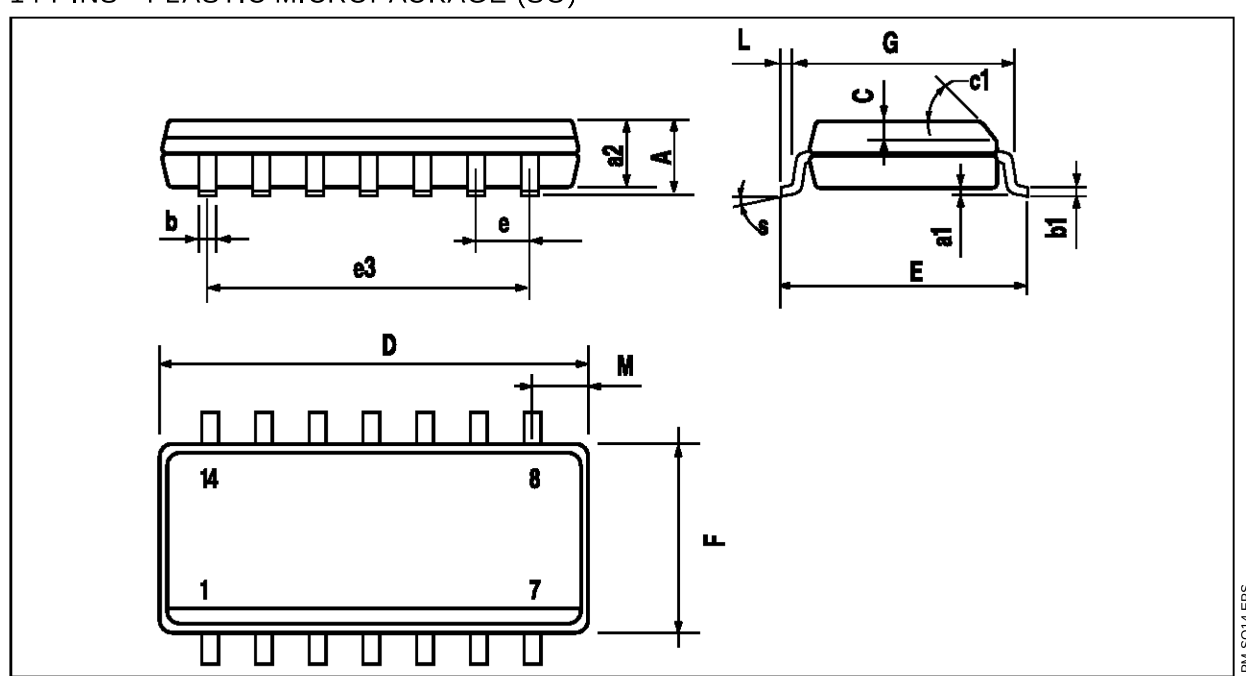


Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
i			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100

DIP14.TBL

PACKAGE MECHANICAL DATA

14 PINS - PLASTIC MICROPACKAGE (SO)



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.2	0.004		0.008
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1	45^o (typ.)					
D	8.55		8.75	0.336		0.334
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.150		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.020		0.050
M			0.68			0.027
S	8^o (max.)					

SO14.TBL